NEW JERSEY

AGRICULTURAL COLLEGE

REPORTS

AND

ANNUAL LECTURE,

1868.

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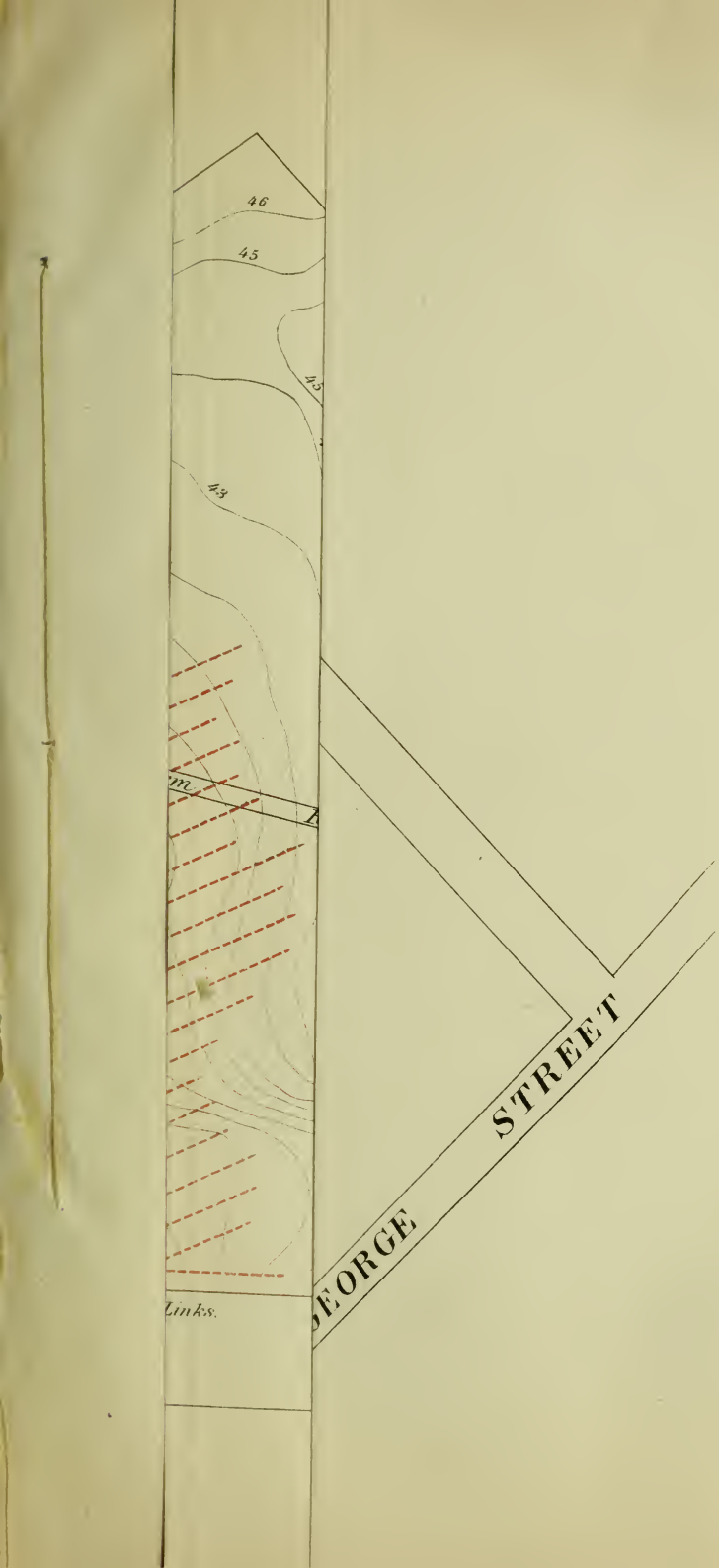

46
45
43
STREET

AG. COLLEGE FARM

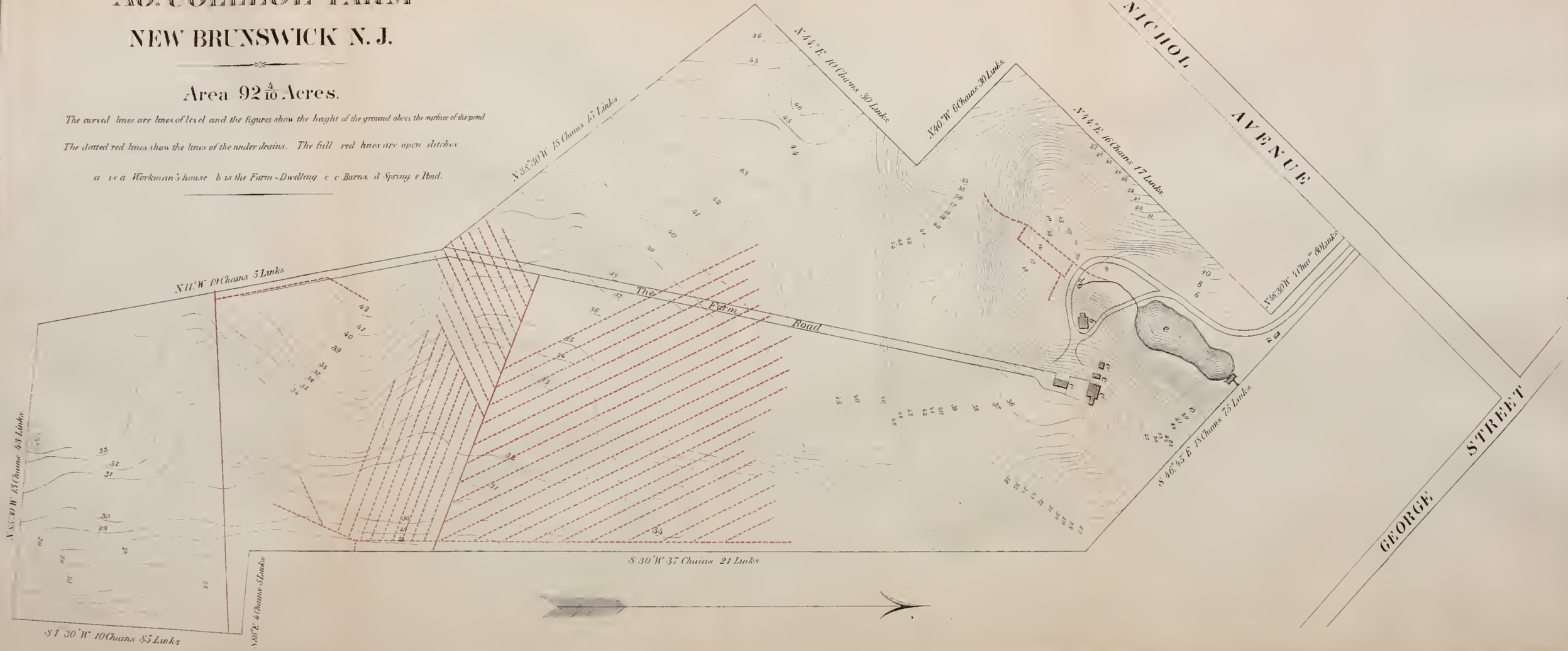
NEW BRUNSWICK N. J.

Area 92 4/10 Acres.

The curved lines are lines of level and the figures show the height of the ground above the surface of the pond

The dotted red lines show the lines of the under drains. The full red lines are open ditches

a is a Workman's house b is the Farm-Dwelling c c Barns. d Spring e Pond.



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BOARD OF VISITORS.

JAMES M. MECUM,	First District.
JONATHAN INGHAM,	" "
WILLIAM HENRY HENDRICKSON,	Second District.
WILLIAM PARRY,	" "
D. KERR FREEMAN,	Third District.
JAMES BISHOP,	" "
[Vacant,]	Fourth District.
[Vacant,]	" "
CORNELIUS VAN VORST,	Fifth District.
SETH BOYDEN,	" "

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[Vacant,]	" "
CORNELIUS VAN VORST,	Fifth District.
SETH BOYDEN,	" "

REPORT OF TRUSTEES.

To His Excellency Marcus L. Ward, Governor of the State of New Jersey:

SIR:—I beg leave to submit the fourth annual report of Rutgers Scientific School, in accordance with the direction of the fourth paragraph of section fifth of the act of Congress, approved July 2, 1862, and section fifth of the act of the Legislature of New Jersey, approved April 4, 1864.

FACULTY OF RUTGER'S SCIENTIFIC SCHOOL.

The Faculty as at present constituted is:

Rev. William Henry Campbell, D. D., LL. D., President, and Professor of Moral Philosophy.

George H. Cook, Ph. D., LL. D., Vice President, and Professor of Chemistry and Agriculture.

David Murray, A. M., Ph. D., Professor of Mathematics, Natural Philosophy and Astronomy.

Rev. Theodore Sanford Doolittle, A. M., Professor of Rhetoric, Logic and Mental Philosophy.

Colonel Josiah Holcomb Kellogg, Brevet Major United States Army, Professor of Civil Engineering and Military Superintendent.

George W. Acherton, A. M., ——— Voorhees, Professor of History, Political Economy, and Constitutional Law.

Francis Cuyler Van Dyck, A. B., Tutor in Chemistry and French.

Isaac E. Hasbrouck, A. B., Tutor in Mathematics and German.

Edward Albert Bowser, B. S., Tutor in Engineering and Mathematics.

ADMISSION.

The terms for admission to the full course of study are as follows:

Applicants must be sixteen years of age, of good moral character, and must sustain a satisfactory examination in English Grammar and Spelling, Geography, Physical Geography, Arithmetic, Algebra to Equations of the Second Degree, three books of Plane, Geometry.

Students desiring to pursue special courses of study in Chemistry, Agriculture and Surveying, are admitted if they are qualified in preparatory studies.

CLASSES.

The classes now in the Institution are:

First—The class organized in September, 1866, and which will be graduated in June, 1869.

Second—The class organized in September, 1867.

Third—The class just organized in September, 1868.

The first class contains at the present time nine students; the second, eleven students, and the third, seventeen students. Total—thirty-seven. There have been in this Institution during the year fifty-four persons. Of these, seven were from the State of New York, one from Pennsylvania, four from Japan, and the remainder (forty-two in number) from the State of New Jersey. The counties being represented as follows:

Bergen county,	1
Cumberland "	1
Essex, "	5
Mercer, "	4
Middlesex, "	18
Monmouth, "	3
Morris, "	1
Passaic, "	1
Somerset "	5
Union, "	3
Total,	42

STUDIES OF THE CLASSES.

Since the date of the last annual report the classes have pursued, with unimportant variations, the course of study given in the Appendix. Experience has revealed that sometimes too much work has been allotted to one term, and too little to another. These difficulties are gradually being overcome and the course of study being developed into a consistent and effective system.

The change, proposed last year and sanctioned by the Board of Visitors, was introduced at the beginning of the College year in September. This change required a preparation in Physical Geography and in three books in Plane Geometry in addition, as conditions for entering the Third Class.

The appointment of the Voorhees Professor of History, Political Economy and Constitutional Law, will add to the efficiency of the in-

struction in these important departments of a liberal education. The duties of this professorship extend to the students in the Scientific School, as well as to the other classes in Rutgers College. George W. Atherton, A. M., now Professor of History and Social Science in the Illinois Industrial University, has been elected to this Professorship, and will enter upon his duties at the beginning of the second term, January, 1869.

The large majority of students in all the classes thus far have elected to pursue the course of study particularly designed to teach Engineering and Mechanics. Those who have desired to pursue Analytical Chemistry and Agriculture, have had the facilities afforded to them, and have been under the special charge of the Professor of Agriculture and Chemistry, Dr. Cook.

GRADUATING CLASS.

At the last Commencement of the College, in June, 1868, the first class of this institution was graduated and admitted to the degree of Bachelor of Science. It consisted of seven members, who pronounced theses on the following subjects:

Charles Barnes, of Poughkeepsie, N. Y., "Progress of Astronomy."

Edward Albert Bowser, of Brooklyn, N. Y., "Our Country's Demand for Schools of Science."

Garretson Hageman, of Middlebush, N. J., "Light."

George Howell, of Roadstown, N. J., "Instability of the Land."

William Edward Kelly, of New Brunswick, N. J., "La Machine a Vapeur."

Edward Clarence Pearson, of Elizabeth, N. J., "Physical Constitution of Matter."

Floyd Marvin Vanderoef, of Florida, N. Y., "Mineralogy."

Of these theses the best was adjudged to have been presented by Mr. Bowser, and the second best by Mr. Kelly, and a prize offered by the Professor of Mathematics was awarded accordingly.

The friends of the Institution have watched with interest the time when it should graduate its first class and send it out into the world. It is this practical test which the character and attainments of its graduates can furnish by which the Institution can most fairly be judged. It has taken these three years before such a test could be supplied. The course of study has not been arranged with reference to an easy career for young men, but with reference to developing the best talents and most earnest efforts on the part of those who would faithfully pursue it. Hence not a few young men have failed to reach the requisite standard. But to those who have successfully passed through the course of study and received the diploma of the Institution we can point with satisfaction. The best evidence of the appreciation in which their attainments are held is the readiness with which

these young men have found suitable openings for their services, and the satisfaction which they are giving in them.

MILITARY EXERCISES.

During the Spring and Autumn terms the members of the Scientific School have been drilled by the Military Superintendent, Col. Josiah H. Kellogg, Brevet Major, United States Army, in the manual of arms, and also in company evolutions. The graduating class were also instructed by Col. Kellogg, in the subjects of military engineering and field fortifications.

The arms and accoutrements furnished by the Quartermaster General of the State, have been in use by the students, and are properly secured and cared for in the armory provided for them by the trustees. These arms are now in good condition.

AGRICULTURAL LECTURES.

The requirements of the law in relation to lectures on agriculture in each of the counties, has been fulfilled. The attendance upon these lectures is not large, though in the agricultural counties they call out some of the most enterprising and thoughtful farmers. The printing of these lectures and their distribution by the Legislature, has given them a much fuller circulation and more extended influence than they could otherwise have. The matter in the lectures as they are printed supplies a kind of information in relation to New Jersey agriculture, which cannot be had in any other way. There were, for example, in the lecture of 1867, which was upon fertilizers, analyses of Peruvian guano, of cancerine from Cape May, of fish guano from Monmouth county, of mussels, corals and sea weed from Ocean county, of two samples of glue maker's bone-dust, of three characteristic superphosphates which are in common use, of six green-sand marls from different parts of the State, of common oyster shells, and of three varieties of limestone which are used for lime within the State.

These analyses have furnished the basis of many comparative trials of manure by farmers in different parts of the State. As intelligence advances the press has more and more influence, and there can be no doubt that these lectures will do more for the farmers by their general circulation in print, than at their delivery. There are questions in our agriculture which are continually arising with the extension of our settlements, and the demands of our markets which might profitably occupy the energies of the Agricultural College, if the whole of its means were directed to them.

EXPERIMENTAL FARM.

This branch of the Agricultural College is in active use. Experi-

ments in underdraining, in renovating worn out land, and in clearing new ground, are in progress, extensive trials of fertilizers of different kinds are being made, and the advantages of choice implements and stock are being carefully tested. The charge of the Farm is given to the Professor of Agriculture, and we refer to his appended description and account of its operations for full particulars.

The expenses attending an undertaking of this public character, have been found much greater than would at first be supposed; and it is a burden on the funds of the Institution. Its usefulness, however, is undoubted, and we think it will make itself appreciated by the State.

The amount received from the State Treasury during the fiscal year from November 30, 1867, to November 30, 1868, is $6,924, all of which has been expended exclusively for the salaries of professors in the Scientific School.

All of which is most respectfully submitted in behalf of the Trustees of Rutger's College.

WM. H. CAMPBELL,
President of the Board of Trustees.

New Brunswick, November 30, 1868.

REPORT OF BOARD OF VISITORS.

To the Honorable the Senate and General Assembly of the State of New Jersey:

The Board of Visitors of the New Jersey State College for the benefit of Agriculture and the Mechanic Arts, beg leave respectfully to submit their fifth annual report.

The Board have discharged the duty assigned to them in the act of the legislature by which it was established. They have made two visits to the Institution during the year ending November 30th, 1868; the first on the 11th day of June, and the second on the 22d day of December. On both these occasions the classes pursuing their studies in the institution were examined in their presence by the professors having them in charge. The Board also witnessed the exercises in Military Drill, conducted by the Military Superintendent, Col. J. H. Kellogg. They inspected the condition of the arms issued by the Quartermaster General to the Institution, and found them in good condition and properly cared for. They visited the farm which is maintained by the Trustees of the College, for the benefit of the students in Agriculture, and which is now in charge of the Professor of Agriculture, George H. Cook, LL. D. They inspected the building, provided for the institution, and heard reports of the condition progress and prospects of the Institution from President Campbell, and the other Professors.

From the evidence furnished by these visits, the Board feel themselves fully authorized in reporting the Institution in a satisfactory condition. The instruction given to the classes is thorough and practical, and suited to the wants of the young men. The first class, which has completed its entire course of study in the College, was graduated and received their diplomas at the commencement in June, 1868. It consisted of seven members, as follows: Edward Albert Bowser, Charles Barnes, Garretson Hageman, George Howell, William Edward Kelly, Edward Clarence Pearson, Floyd Marvin Vanderoef.

The high standard of scholarship which these young men had maintained during their course, and the readiness with which their

services found suitable employment, are gratifying evidences of the success of their education. Mr. Bowser is retained as a Tutor of Mathematics in Rutger's College. Mr. Howell is in the employ of the New Jersey Railroad as an engineer. Mr. Hageman is pursuing his anticipated career as a farmer. Mr. Kelly is practicing his profession of Mechanical Engineer in a large foundry and machine shop. Mr. Pearson is employed as a teacher in the Newark Academy. Mr. Vanderoef is in the employ of the New Jersey Geological Survey, arranging, classifying and labelling the geological and mineralogical specimens.

The Agricultural Farm connected with the College shows the effects of the system of improvements which have been initiated. The rearrangement of the buildings, the extension and carefully planned system of underdrainage, the systematic use of manures, the gradual subjection of all parts of the farm to cultivation, are rapidly bringing the farm into excellent order. The Board take pleasure in calling attention to the map and description of the farm, which will be found appended to the Report of the Board of Trustees.

The Professor of Agriculture, Dr. Cook, has, in accordance with the provisions of the law, delivered a lecture on the subject of Agriculture in each of the counties of the State. We herewith transmit a copy of this lecture, and with a view to its more general diffusion among the Agriculturists of the State, recommend that it be printed with this report. The delivery of these lectures and their general diffusion must be of great value to the cause of Agricultural progress. It is unfortunate that in many cases the provision for their delivery before suitable audiences has been inadequate to their value. In this way the usefulness of the plan contemplated in the law for the delivery of Agricultural lectures in the counties has been very much interfered with. It would seem but reasonable that inasmuch as the law requires these lectures to be delivered annually, it should also be made the official duty of somebody in each county to make the necessary arrangements for them.

The Board of Visitors found that the representation of State students from many of the counties was defective. The whole number of students which the State is entitled to send to the Institution is forty. The number actually in attendance of State students is sixteen. The Trustees have used their best endeavors to secure a full representation from all the counties. They have addressed circulars to the County Superintendents of Schools, whose duty it is to make the nominations of pupils, asking their active interest in sending the full quota from each county. It is hoped that these measures and the gradual extending of information and awakening an interest in industrial education, will result in rendering this great public benefaction more widely useful to the persons for whom it has been designed.

The Board take this opportunity to report that two vacancies exist

at the present time and a third will occur on the 12th day of April next. The Board has lost two of its most active and efficient members by the removal from the bounds of the State, of the Rev. Dr. Dashiell, of Orange, and by the resignation of John Cooke, Esq., of Paterson. Both these vacancies are in the Fourth District. The term of office of Cornelius Van Vorst, of Jersey City, also expires by law on the 12th of April next.

In closing this report the Board of Visitors beg leave to commend to your fostering care the institution under their inspection, and to renew the expression of their conviction that the trust committed to the Trustees of Rutgers College is being administered with commendable fidelity and wisdom.

All of which is respectfully submitted.

WM. H. HENDRICKSON,
President Board of Visitors.

APPENDIX.

APPENDIX A.

ARRANGEMENT OF STUDIES.

FIRST YEAR—THIRD CLASS.

First Term.

1. Loomis' Algebra, from Quadratic Equations to Infinite Series.
2. Loomis' Geometry, from Book IV.
3. Draughting; elementary principles and construction of Problems.
4. Agassiz and Gould's Elementary Principles of Zoology.
5. Principles of Elocution and Exercises in Composition and Declamation.
6. French.

Second Term.

1. Loomis' Algebra finished.
2. Trigonometry, Plane and Spherical.
3. Geometrical Draughting.
4. Meteorology and modes of keeping Meteorological Register.
5. History, and Exercises in Composition and Declamation.
6. French.

Third Term.

1. Surveying, with Field Exercises.
2. Descriptive Geometry—Church.
3. Elements of Botany.
4. History, and Exercises in Composition and Declamation.
5. Draughting.
6. French.

SECOND YEAR—SECOND CLASS.

First Term.

1. Analytical Geometry, Loomis, with additional notes on three dimensions.

2. Leveling, and Railroad Curves with Exercises.
3. Shades, Shadows and Perspective—Church.
4. Elements of Chemistry and Mineralogy.
5. Rhetoric—Exercises in Composition and Declamation.
6. German.

Second Term.

1. Differential and Integral Calculus.
2. Physics and General Chemistry.
3. Mental Philosophy.
4. German.

Elective Studies.

5. Analytical Chemistry and practice in the Laboratory.

Third Term.

1. Mechanics, Bartlett's begun.
2. Optics and Acoustics, Bartlett's.
3. Mental Philosophy.
4. German.

Elective.

5. Analytical Chemistry Quantitative Analysis.
6. Silliman's Principles of Natural Philosophy.

THIRD YEAR—FIRST CLASS.

First Term.

1. Bartlett's Mechanics finished.
2. Astronomy and use of Astronomical Instruments.
3. Mahan's Civil Engineering.
4. Moral Philosophy.

Elective.

1. Metallurgy and Mining.
2. Principles of Agriculture and farm accounts.

Second Term.

1. Geodesy, Lectures and Exercises.
2. Mahan's Civil Engineering.

3. Stone Cutting.
4. Political Economy.

Elective.

2. Technology.
3. Agriculture, its methods and products.

Third Term.

1. Mahan's Civil Engineering.
2. Lectures in Architecture.
3. Constitutional Law.
4. Military Engineering.

Elective.

Agriculture, Horticulture, Products, &c.

APPENDIX B.

Copy of Circular sent to the County Superintendents of Common Schools.

NEW JERSEY STATE COLLEGE,
NOVEMBER 15, 1868.

DEAR SIR :—By the terms of the act of the Legislature you are entrusted with the duty of examining and recommending the students who are to enjoy the benefits of the State College of Agriculture and the Mechanic Arts. A certain number of students from each county thus recommended and appointed are entitled to be educated free of expense for tuition at this Institution during a course of study of three years. The endowment of this Institution is the gift of the Government of the United States, and the enjoyment of this educational privilege is the *right* of those who may be appointed, and in no sense a *charity*. Your county is entitled to a representation of student , of whom at present in attendance.

The conditions for admission at the beginning of the College year are a satisfactory examination in

English Grammar and Spelling,
Common and Physical Geography,
Algebra to Equations of the Second Degree,
And Three Books of Plane Geometry.

If the students should be appointed and enter at the beginning of the second term, January, 1869, they will require to be prepared also in Algebra to Infinite Series, in Geometry to Book IX in Loomis, and in Agassiz and Gould's Elements of Zoology.

I invite your attention to this subject, and respectfully suggest that in your official visits you should look out among the schools under your charge for suitable and promising young men to be appointed to fill these vacancies, and urge them to avail themselves of this opportunity to obtain a liberal education. The character of the course of instruction you will see by the accompanying catalogue. The Institution has been now in operation for three years, and sent out its first class of graduates at the last Commencement. The character of these graduates and the readiness with which their services have found active

and remunerative employment, are the best recommendations of the Institution.

Any further information will be cheerfully rendered either to you or to any other applicants.

Very Respectfully,

W. H. CAMPBELL, *President.*

APPENDIX C.

THE EXPERIMENTAL FARM.

The impoverished condition in which the farm was when purchased, has required a constant outlay of labor and money to bring it into a condition for raising crops. The progress made up to this time will be best understood by a reference to the accompanying map of the property.

The farm is in the outskirts of New Brunswick, (George street,) which is shown on the northeast side of the map, runs directly through the city to the New Jersey Railroad depot, which is $1\frac{1}{8}$ miles northwest from the corner of George street and Nichol avenue, also shown on map. The farm, it will be seen, did not border on any street, but had an outlet on George street, crossing the property of James Neilson, Esq. It contained one hundred acres. Of this, fifty acres, the northwestern half, were dry, mellow farm land, entirely worn out, but capable of improvement. This was divided up into fields, by fences and wide hedge rows. Sixteen acres were in pasture; poor and wet, but cleared, except the thickets along the fences. The remaining thirty-four acres was wood-land that had been cut off a few years before, and grown up in sprouts. Some portions of this were wet and swampy and others were dry.

The farm map has contour lines, or lines of level marked on it. These lines are on the surface of the ground, are level throughout their whole length, and marked in feet and tenths so as to show the height of each one. The reference level is the surface of water in the pond. A little study of these lines will show the way the ground slopes, how to lay out the drains so as to get the best results and at the least expense of labor and tiles. The lines marked on the map show where tile drains have been laid. The notch on the west corner of the farm has been taken for the reservoir of the New Brunswick Water Works. The entrance has been changed so as be from Nichol avenue. The barn has been removed from the reservoir near to the other buildings, and a large cellar for roots made under it. A dwelling has been built for a workman's family. The division fences have all been taken up and the hedge rows cleared. A lane extending through the farm, so as to give convenient access to any part of it, has been fenced in. It is not designed to have any other permanent

fences. Temporary fences will be put up, whenever in the rotation of crops the land is needed for pasturage. The rotation may be a four years one in fields of from fifteen to twenty acres each, leaving the rest of the land to be occupied with fruit and market garden crops.

The whole of the pasture land and about six acres of the bush ground have been thoroughly underdrained. A part of the ditches have been dug two and a half feet deep and thirty feet apart, and others three feet deep and forty feet apart. Some sole tile have been laid, and some large round tile; but the best lines have been laid with two-inch pipe tile, with rings to slip over the joints. The Crossman Clay Company, of Woodbridge, have supplied us with pipe tile of superior quality, made by their machines. The tile are remarkable for being so true to their form. Five hundred and seventeen rods of tile were laid last year. Nine hundred and sixty rods have been laid this year, at a cost of seven hundred and thirty dollars. Some more draining will be needed when the ground is cleared, but the largest part is now done. The old pasture ground is drained, plowed and seeded to meadow grass. The land which formerly was too wet for tillage is now as dry as any on the farm. Six acres of the bush land is plowed and seeded with rye and clover, and twelve acres more are being prepared for next summer's crops, and the remainder will be brought into cultivation as soon as it can be done with economy.

There has been a public trial of McKenney's Buckeye Grubber and Stump-puller on some of the uncleared grounds. It is operated by horse-power, works with remarkable quickness, and for taking out all medium and small sized stumps and grubs it seems to be admirably well adapted. We shall give it a careful trial this winter and spring upon five acres of wood land that was cut off about twenty-five years ago, and has grown up again.

An exhibition of Mowing Machines was also held on the farm in June last, but no judges were appointed.

The farm has been stocked with an excellent pair of horses and a pair of mules. It is proper to acknowledge the favor of N. W. Morris & Sons, in supplying the farm with an extra good pair of mules at a medium price.

Of cows we have four full-blooded Ayrshires, two Short-horns, and four natives. Also a pure Alderney heifer and bull, and a pure blooded Ayrshire heifer and bull. The design is to keep as large a stock of milch cows as is necessary to consume all the corn-stalks and nutritious but unsaleable fodder, and to make as large a supply of manure as possible.

Trials of fertilizers are in progress. The following have been analyzed in our laboratory, and are now on trial on the growing wheat:

ANALYSES.

	1	2	3	4	5	6	7	8	9	10	11
Soluble Phosphoric Acid	8.8	7.2	5.3	3.6	7.1	5 4	0.9	0.7	....	3.8	.....
Insoluble Phosphoric Acid	5.7	6.4	8.2	13.8	8.1	9.4	....	....	15.5	8.7	.....
Sulphuric Acid	17.9	19.1	17.9	12.4	14.6	18.4	....	....	9.4	17.1	.....
Lime	16.2	15.5	15 7	24.0	15.2	16 5	7.2	....	33.4	13.6	0.9
Magnesia	1.0	3.7	3.7	....	....	.....	....	....	1.5	0.8	0.2
Oxide of Iron and Alumina	0.8	1.8	6.4	7.2	24.	7.6	8.1	....	1.1	2.8	.....
Insoluble Matter	2.0	3.2	3.0	6.5	4.8	5.8	....	....	3.5	7.4	5.8
Organic Matter	31.7	22.4	18.5	31.4	46.0	34.8	23.6	24.9	34.8	25.8	93.1
Water	16.2	18.8	20.0	....	....	3.9	10.9	5.1	....	19.3	.....
Total	100.1	98.1	98.7	98.9	98.2	101.8	....	....	99.2	101.3	100.0
Ammonia	3.0	2.3	1.3	1.0	2.5	2.7	1.6	1.3	3.2	2.4	15.6

In the above table of analyses, No. 1 is Coes' Super-phosphate; No. 2, Lister's Super-phosphate; No. 3, Robison's; No. 4, Berger & Butz's; No. 5, Pacific Guano; No. 6, Deys' Nitro-phosphate of Lime; No. 7, Double Refined Poudrette; No. 8, Poudrette; No. 9, Deys' Bone Dust; No. 10, Phuine; No. 11, Horn Dust.

This year we have used profitably guano, poudrette, nitro-phosphate of lime, and marl. Experiments with composts of marl and barn-yard manure, and with marl and meat scraps are in progress, and we hope for useful and instructive results from them.

DONATIONS.

The Farm has received the following donations within the calendar year 1868:

IMPLEMENTS.

From the owners of the patent, a Stelle & McDonald's Rotary Harrow and Cultivator.

This implement stirs the ground much like the digging fork. It is drawn by two horses, works a strip of ground four feet wide, and from one to eleven inches deep. It is claimed by the inventors that for preparing raw ground for spring crops, and for the thorough pulverizing of the soil, it will do the same work better, and at half the cost of the common plow and harrow. It was not received in time for a thorough trial.

From Collins & Co., 212 Water street, New York, a Smith's cart cast-steel plow, with wheel and common coulters.

This plow has been very satisfactorily tried. It scours in all soils, does good work, and is remarkable for ease of draught. Our workmen are unwilling to use any other plow after trial of this.

From A. L. Brearley & Co., Eureka Agricultural Works, Trenton, a Phifer Wheel Gang Plow and Cultivator.

This machine has been thoroughly tried, and has given entire satisfaction. It has saved a good deal of labor and has done its work well.

From the Ames Plow Co., of Boston, Mass., Burt's Self-adjusting Horse Rake.

This unpromising looking rake worked admirably. It was us during the entire haying season, and also gleaned all the grain.

From Belcher & Taylor, Agricultural Tool Co., Chicopee Falls, Mass., a self-sharpening straw and stalk cutter, for either hand or horse power, though we have only tried it by hand. It has been in daily use during the season. It works well, keeps in good order, and has cost nothing for repairs.

From C. P. Strong, Esq., dealer in agricultural implements and hardware, New Brunswick, N. J., a right hand corn-sheller, from Chicopee Falls, Mass.—a first-rate hand machine.

From ——— Wakefield, of Pittsfield, Mass., a hand corn planter, which has not been tried.

FERTILIZERS.

From the West Jersey Marl Company, one hundred and forty tons of marl. This has been used mainly on grass land, as a top dressing, about six tons to the acre, and the remainder is being composted with other fertilizers. The grass crops where it was applied last year, still show its good effects.

From the Pemberton Marl Company, twenty tons of marl, mostly used upon potatoes in the hill. The crop of grass where the Pemberton marl was applied last year was very good.

From the Lodi Manufacturing Company, James R. Dey, President, ten tons double refined poudrette. This was used on corn, potatoes, cabbage, carrots and beets, in fact was our reliance for the season's supply, taking a place we could not have otherwise filled, and paying double its price.

Also, ten barrels nitro phosphate of lime from the same source. This was tested on corn, beets and carrots, and is now being tried on wheat, and is a good fertilizer.

Three barrels of fine bone dust were also received from the same company, and are now on the crop of growing wheat.

The following fertilizers are now on trial on the winter wheat ground:

From Lister Brothers, Passaic Carbon Works, East River street, Newark, N. J., eight barrels of fresh bone meal and four barrels of superphosphate.

From E. Frank Coe, of Williamsburgh, L. I., eight barrels of ammoniated superphosphate of lime.

From J. B. J. Robison of Newark, N. J., seven bags of phosphate.

From J. V. D. Hoagland, of Millstone, agent, two bags Rhodes' superphospate.

From M. D. Shoemaker, Philadelphia, four barrels of Phuine.

From B. Prentiss, of Philadelphia, two bags of horn dust.

The following were used on potatoes:

From Berger & Butz, Philadelphia, two bags of excelsior phosphate.

From I J. Conover, agent, Freehold, N. J., two bags Pacific guano.

From Garretson & Wright, agents, New Brunswick, N. J., two bags Baugh's Peruvian guano substitute; two bags Baugh's raw bone superphospate.

There were also received—

From Hon. Willian Parry, Cinnaminson, N. J., one dozen Wilson's early blackberry plants, one dozen Philadelphia raspberry plants, and one hundred Doolittle raspberry plants.

From Daniel McLaury, Cold Spring Farm, New Brunswick, N. J., one dozen Wilson's early blackberry plants, three Davis' thornless raspberry.

From David Petit, Salem, N. J., one bushel of choice seed corn.

From Thomas E. McDonald, of Piscataway, N. J., a half bushel Jackson white potatoes.

The uses of an experimental farm are but vaguely defined as yet. In the midst of a community of skilful and energetic farmers, market-gardners and fruit-growers, it would be difficult to show better specimens of neat, thorough and successful tillage than are everywhere around us, or to make a more judicious or economical use of labor and capital.

There are questions on fertilizers, in which experimental chemistry must be joined to the practical operations which must naturally find their answer on such farms. Experiments which require the use of weights and measures and of careful records, may also be properly tried here. And the Farm is being used for such purposes, and being prepared for more extensive use.

APPENDIX D.

ANNUAL LECTURE ON AGRICULTURE.

NEW JERSEY STATE AGRICULTURAL COLLEGE.

1868.

ON THE RESULTS OF THE GEOLOGICAL SURVEY OF NEW JERSEY.

The Geological Survey of New Jersey was instituted for the development of its resources—mineral and agricultural. The Final Report and Maps of the Survey are about to be published, and I cannot present any subject of more general interest to farmers than some of the results of this State Survey. The soils are derived mainly from the rocks on which they lie, and when the geologist has faithfully mapped out the different rocks of the State, with their boundaries, he has in fact shown the different kinds of soil found in the State. These soils, made by the disintegration or wearing down of rocks, possess peculiarities of texture and composition, and require special management for their most profitable cultivation. The slate soils of Sussex and Warren are specially adapted to dairying. The limestone soils are remarkable for their adaptation to grain; the red sandstone and shale soils are valuable for mixed farming; the marl region is remarkable for its potatoes; and the sandy loams of South Jersey for their early growth of vegetable and semi-tropical fruits. The most successful management of each of these soils will be found applicable throughout, but not adapted to the requirements of the other soils.

In some parts of Salem county, where the agriculture is as successful as in any part of the United States, good farmers plough only from three to five inches deep for their best crops, and by trial they have found that deeper ploughing, or subsoiling, has diminished the yield of their staple products. Their subsoil is sufficiently open for air, water and roots to penetrate it, and by shallow ploughing the manures are kept close to the surface where they can produce their best effects. This mode of ploughing would be ruinous to a farmer on

the red shale soil where neither air, water nor roots can sink lower than the plow loosens the soil. So the treatment of a sandy loam needs to be entirely different from that of a stiff clay. The geology of the soils and rocks is of fundamental importance to farmers.

In giving the results of the geological survey, I will first speak of the maps upon which the work is laid down, then of the coloring of the maps and the outlines of the different formations, afterwards of the rock structure of the country, and then of the chemical examinations of soils and fertilizers; and lastly, make some reference to the geological history of the various formations.

The principal maps of the survey—four in number—cover the State. They are drawn on a scale of two miles to an inch, and are large enough to show all the roads and streams in the State. They are made in part from old material, and partly from data that have not been used before this. The whole eastern border of New Jersey from the State line to Cape May, and then on the west up Delaware Bay and River to Lambertville, has been carefully surveyed by the U. S. Coast Survey, and many latitudes and longitudes determined with great care. These we have had free access to, with permission to take from them such matter as we needed. The survey of 1854–5–6 did much preparatory work towards making a topographical map of the several counties. Though mostly unfinished, these surveys have been found useful in making the maps. They have also been subject to the criticism of competent persons in different parts of the State, and have been corrected by them. Together these maps form a new and improved geographical map of the State, and a few copies have been joined into one for this purpose, which makes a large map five and a half feet wide and seven and one quarter feet long. For showing the geological formations they are retained in the four parts. The titles of these are as follows:

1. *Azoic and Paleozoic Formations: Including the iron ore and limestone districts.*

2. *Triassic Formation: Including the red sandstone and trap rocks of New Jersey.*

3. *Cretaceous Formation: Including the green sand marl beds.*

4. *Tertiary and Recent Formations of Southern New Jersey.*

The Azoic Formation occupies the southeastern part of Sussex and Warren counties, the northwestern parts of Passaic and Bergen, most of Morris, and a little of Somerset and Hunterdon.

The Paleozoic Formations occupy the northwestern portions of Sussex and Warren counties, the Green Pond Mountains in Passaic and Morris counties, and the limestone valley of the South Branch, in Morris and Hunterdon counties.

The Triassic and Red Sandstone Formation, occupies the belt of country which crosses the State from northeast to southwest, adjoining the Highland Range on the southeast. Almost the whole of Bergen, half of Passaic, all of Essex and Union, a part of Morris, most

of Somerset and Hunterdon, and considerable portions of Middlesex and Mercer counties, are of this geological age. Its southeast border is nearly on a straight line between Jersey City and Trenton.

The Cretaceous Formation is found immediately southeast of the red sandstone, in a long and narrow strip which reaches from Raritan and Sandy Hook Bays to the Delaware Bay near Salem, parts of Middlesex, Mercer, Monmouth, Ocean, Burlington, Camden, Gloucester and Salem counties, are of this geological period.

The Tertiary and Recent Formations are almost entirely limited to the southern part of the State, below the Cretaceous. They cover the counties of Atlantic, Cumberland and Cape May, and most of Ocean, Burlington, Camden, Gloucester and Salem are partly occupied by them, and also a small portion of Mo mouth.

Of these five divisions the Azoic and Paleozoic run into each other so as to require a single map for their surface delineation. The other three are so entirely distinct from one another that they can easily be drawn in separate maps. And the work has been thus done. The general maps are on a scale of two miles to an inch.

5. *A map of a group of Iron Mines* in Morris county, on a scale of three inches to a mile. This map extends from the lower end of Succasunny Plains to the upper end of Split-Rock Pond, a distance of fourteen miles, and with a breadth of five miles, covering an area of seventy square miles. More than fifty mines are marked upon the map, their location being shown by full red lines, and their attractions, as far as they affect the miner's compass, also marked upon the map in dotted red lines. The object of this map is to show the mines in their proper locations and directions, and in this way to furnish guides and suggestions for those who desire to make further researches for iron ore.

6. *A map of the Ringwood Iron Mines* in Passaic county, on a scale of eight inches to a mile. This covers an area of about two square miles. It shows a remarkably regular and uniform series of offsets between the different ranges

7. *A map of the Oxford Furnace Iron Ore* veins in Warren county. It is on a scale of eight inches to a mile, and covers about three and a half square miles. Several distinct veins of ore are marked upon it. They are remarkable for their irregularity in position, and for running northwest and southeast instead of in the usual northeast and southwest direction.

8. *A map of the Zinc Mines in Sussex county*, on a scale of eight inches to a mile. The map includes the mines at Stirling and Mine Hills. It covers a strip of country three and a half miles long and a mile wide. The remarkable curves in the zinc veins are laid down, and the iron ore veins about Franklin Furnace are also shown. The structure of the zinc veins is the same as that of the iron ore, and they are traced by the miner's compass in the same way—the mineral Franklinite affecting the magnetic needle.

The colors on the maps are intended to mark the various geological formations of the State, and by their outlines to show the boundaries within which these formations are limited.

Within the boundaries of New Jersey rocks are found representing nearly all the periods of geological history, from the earliest to the most recent. The only important member of the series wanting is the Coal Formation. Crimson marks the gneiss, blue the limestone, neutral tint the slate, light red the red sandstone, deep red the trap, green the marl, &c.

These outlines or boundaries have been a laborious part of the work, and they are as accurate as we have been able to make them. When it is remembered that the materials of the earth are arranged according to a *plan*, and that useful substances are not scattered about irregularly, but are found in their appropriate rocks and formations only, it will readily be understood that this outlining of the formations is of practical importance. Our magnetic iron ores are only found in the rocks of gneiss and white limestone. No one should waste money in mining for iron ore outside the district where it occurs. Ninety-nine hundredths of all the coal in the world, is in the Coal Formation. This formation does not occur in New Jersey, and no one need waste money in looking for it.

Limestones occur in regular beds, and these have been marked out on the map. The green sand marls are all found in one belt of country. There has been much inquiry and search for marl outside this belt, but none has been or will be found. The fine white clays in our State are confined to one formation. For want of a knowledge of this elementary truth of Geology, thousands of dollars are squandered every year. The geological structure of the State is given at length in the report, and its illustrations and maps. It is probable that the stratified rocks which compose the crust of the earth were once level or nearly so, but they have since been upheaved to various degrees of inclination from the slightest inclination quite up to the vertical. In some cases the rocks have been folded or doubled closely together, and the whole left standing on edge. The knowledge of these facts finds its use in mining, and searching for building stone, marl, &c. By this folding, beds of iron ore are brought to the surface in some parts of their extent, so that they can be found without the necessity of blasting rocks, or being at other heavy expense before we are sure that ore in paying quantity exists. So in regard to searches for coal. In several places deep and expensive borings have been made in the red sandstone to find coal, when it is perfectly evident that if the rock contains any coal beds they will outcrop on the surface somewhere and save any necessity for boring. For all the rock dips toward the northwest, and whatever layer may be in it—if it were at the depth of one hundred feet—it would by the rise of the strata come to the surface on some line not more than five hundred feet southeast from the point of inquiry. In the case of

strata of clay or marl, costly experiments are sometimes made in boring, on high grounds, when an examination of the bank of some ravine in the neighborhood would give the same information, and at one-third the cost. An instance was noticed of a shaft being sunk near the brow of a hill, at a heavy cost, when a half hour's examination on the slope of the hill would have made the matter as plain as it was after the work had been done. So in the searches for marl, a knowledge of its thickness, inclination and slope, enables a surveyor to tell how far it lies beneath the surface at any place, how much earth must be removed to uncover it, and how best to arrange for its drainage and extraction. The knowledge of structure furnishes information as to prospective continuance of deposits of useful material. The knowledge of the structure of our veins of iron ore, leads to the conclusion that the amount of ore is vastly greater than was supposed a few years ago, and that the work in these mines will be limited by the trouble of getting it to the surface rather than by exhausting the ore. So in our stores of marl, the structure of the beds proves them to be perfectly inexhaustible, only as they descend towards the southeast they get farther beneath the surface, and it may cost more to get marl out than it does now. But art is advancing, and when need for improvement comes, the want will be met. Some of the iron mines are now five hundred feet deep, and it costs no more now to get a ton to the surface than it formerly did when they were fifty feet deep.

The chemical composition of the rocks and soils—classed as they can be geologically—is of the highest interest.

The rocks of the Azoic region contain a large percentage of feldspar. This mineral varies in its properties according as potash, soda or lime predominates. That containing potash is hardly affected by weather and exposure while that containing soda or lime crumbles and decays easily.

This explains why the surface is so smooth, and the rock so much decomposed in all the country in the north part of Hunterdon, and the adjoining parts of Warren and Somerset.

A feldspar from Trenton, which is singularly liable to decay, where in fact large portions of the rock is now decayed, was found to contain 16.5 per cent. of soda. A feldspar from Central Park in New York, which was very solid and apparently unchangeable, was found to contain 12.8 per cent. of potash. A sofa and crumbling feldspar from a cut in the Central Railroad above High Bridge was found to have the following composition :

Analysis.

Silica,	57.4
Alumina and a little oxide of iron,	26.4
Lime,	10.3

Soda,	1.8
Potash,	7
Water,	3.6
	100.2

Two other specimens from the Warren Railroad, near Hampton Junction, of which the first mentioned was flesh colored, hard and unchanged, and the second was soft and earthy, gave the following results:

	1	2
Silica,	64.0	66.3
Alumina and a little oxide of iron,	21.6	22.0
Lime,	2.5	4.5
Soda,	11.5	2.6
Potash,		3.0
Water,		1.6
	996	100.0

These facts explain one mode of action which lime may have when applied as a manure. It makes the particles of feldspar in the soil crumble and decompose, giving up their potash to enrich the soil. It gives a hint, too, to the farmers on Azoic soils, as to the importance of using lime to improve their soils, making them mellow, fine and rich, and gradually wearing out the stones that encumber them.

The analysis of the subsoils from the limestone valleys of Sussex, Warren, Morris and Hunterdon, explains the inexhaustible fertility of the of these regions. When all the rest of the country east of the Alleghanies had been worn down by exhausting tillage, these limestone valleys retained all their original productiveness. The fertility of the soils of the Kittatinny, the Lancaster, the Cumberland and the Shenandoah Valleys, all of which are underlaid by the Magnesian limestone, is proverbial.

We give the analyses of these subsoils:

Analyses of Subsoils in the Magnesian Limestone.

	1	2	3
Silicia,	61.8	70.7	53.4
Alumina,	21.8	8.5	25.1
Peroxide of Iron,		10.0	6.6
Lime,	....	0.8	0.7
Magnesia,	2.6	0.4	0.4
Potash,	4.6	3.4	2.0
Soda,	1.8	1.6	0.9
Phosphoric Acid,	0.6	1.1	0.8
Water,	6.8	4.2	10.7
	100.0	100.7	100.6

1 is a yellowish earth overlying the limestone at Moore & Curlet's quarry at Newton; 2 is a reddish subsoil from D. Shields' farm, about one mile south of Hackettstown; 3 is a deep red earth from the railroad cut at Washington, Warren county.

They are so rich in phosphoric acid and alkalies, that they might be used to enrich the soil, and they show why the magnesian limestone district has always been rich and productive. It has in its soil enough of phosphoric acid and potash to supply a thousand crops of wheat.

The subsoils are fine, mellow and in excellent condition to yield their constituents to growing crops whenever they are brought to the influence of good tillage. The value of farm land in those valleys can hardly be overestimated. A comparison of these with analyses of soils from the Miami Valley, from the Valley of the Nile, or any others famed for their fertility, will show them not to be inferior to the best, and there is no reason why they should not last as long as the soils of Egypt, which have been famed for their yield of grain for more than 4000 years.

Will it pay to compost these subsoils with lime or fermenting manures? or to haul them on to the azoic or other rocks for fertilizers?

The slate makes a rich and retentive clay soil, remarkable for its adaptation to the growth of grass and the pursuit of dairying. It runs naturally into grass and pasture, of which it supplies the best quality. The following are analyses of slate rock, such as make roofing slate, or when decayed and fine, make the slate soils:

Analyses.

	1	2
Silica,	56.60	68.00
Alumina	21.00	14.40
Protoxide of Iron,	5.65	5.40
Lime,	5.42	2.68
Magnesia,	2.30	1.51
Potash,	1.10	1.76
Soda,	0.50	0.11
Carbonic Acid,	2.20	2.30
Sulphuric Acid,	0.57	. . .
Water,	3.00	2.70
Carbon,	2.69	. . .
	99.03	98.86

No. 1 is the ordinary bluish black roofing slate from the quarry at the Delaware Water-Gap.

No. 2 is an arenaceous, thick bedded slate, and was obtained on

the Deckertown and Port Jervis turnpike, about one mile northwest of Coleville.

The following analyses of red shale and sand-stone from the Triassic Formation show the composition of these rocks and the soils made from them. They contain very little fertilizing matter, but the oxide of iron and alumina fit them to retain whatever fertilizer is put on them, and so yields it up gradually.

It may explain why, under poor husbandry, those soils are so soon exhausted, and under good management seem to be natural to the best growth of almost every crop.

An Analysis of the red shale of the Triassic Formation, as found at New Brunswick, gave the following result:

Silicic Acid and Quartz,	73.00
Peroxide of Iron,	10.00
Alumina,	3.20
Lime,	4.93
Magnesia,	0.90
Potash,	0.73
Soda,	0.97
Sulphuric Acid,	trace.
Carbonic Acid,	. . .
Water,	1.00

The soil of a large portion of the State is made almost directly out of this shale, and the value of such soils is evident from the above figures. The peroxide of iron and lime are especially noticeable.

The utility of chemical examinations is perhaps nowhere better shown than in the analyses of the green sand marls. The early investigators found a large per centage of potash in the marl, and at once jumped to the conclusion that it was potash which gave its fertilizing value. In ashes potash is known to be a most valuable fertilizer, but it is there combined with carbonic acid, and is easily and completely dissolved out by water. In the marl the potash exists in combination with the other bases—oxide of iron, alumina, magnesia, &c., and all of them combined with silicic acid and water—constituting a hydrous silicate of iron, alumina, magnesia and potash. This mineral is in little grains like grains of gunpowder, and is not decomposed or dissolved by water. The marl is found in places where it has been exposed to the weather for perhaps a thousand years, and the change in it is scarcely perceptible. It is probable that under the influence of water and carbonic acid it does dissolve slowly. In cultivated fields where the soil contains most carbonic acid this solution would go on most rapidly. It will also take place where there is considerable pressure; for example in the Artesian well at Winslow where the water is brought from 343 feet beneath the surface, and from the marl bed which is at that depth there, the quantity of carbonates of potash

and soda dissolved is sufficient to be very perceptible in the water. Still the quantity dissolved out of marl is too small to explain the value of that fertilizer. Another and sufficient reason for its fertilizing action can be found in the phosphate of lime which occurs mixed in with the marl. This substance is no necessary part of the marl, though mixed in it as a fine powder, or in soft earthy particles. In the marls which contain no carbonate of lime and yet are valuable as fertilizers, the amount of phosphoric acid varies from one and a half per cent. to three and a half per cent., which is equivalent to from thirty to seventy pounds per ton ; a quantity quite sufficient when its mechanical condition is considered to account for its good effects as a fertilizer. The large sales of marl which are now being made are based on the amount of phosphoric acid contained in them.

Though not quite as quick in its action, it is very certain in its effects, and there is no phosphatic manure offered in our markets so cheap as this. Analysis demonstrates this fact, and experience sanctions it. It has been used for many years, and now, in addition to the hundreds of thousands of tons used in the marl region, there was carried on railroads, and mostly outside the marl region, during 1868, one hundred and thirty-four thousand tons, and provision has been made for doubling this amount within the next two or three years.

The value of these marls, when quickened by the action of lime and animal manures, is only beginning to be appreciated. Many farmers now use composts of marl and manure, and others use composts of lime and marl, and they consider them better than any of these substances used alone. The chemical action which these substances have on each other, or which they may be made to have by drying, burning, fermenting, or other processes, is a proper subject of experiment, and it must become better understood when it receives the attention of inquiring and enterprising farmers.

The demand for fertilizers is increasing year by year, and those farmers who use them in largest quantity are getting the largest profits. If, by the use of marl and peat in composts we can quadruple our supplies of barnyard manure, we can increase the amount of our farm products in almost the same proportion.

The value of lime as a manure is now being more closely observed than ever before. Our magnesian limes have been mostly used heretofore, but it is asserted by those who have tried them in comparison with those containing no magnesia, that the former are not near so valuable for the soil as the latter. The localities where each of these kinds of lime are to be found, are plainly marked out on the map, and it is hoped that we shall soon reach more certain conclusions in regard to this very practical question. The circumstances in regard to these varieties of lime will be better understood by a comparison of the lime from magnesian limestone (1), that from a pure limestone (2), and that from oyster shells (3).

Analyses.

	1	2	3
Lime,	57.9	95.2	94.1
Magnesia,	33.6	.9	2.8
Alkalies,	0.0	0.0	0.8
Alumina and Oxide of Iron,	5.5	2.3	0.0
Silica,	3.0	1.6	0.0
Sulphuric Acid,	0.0	0.0	1.3
Phosphoric Acid,	0.0	0.0	0.2
Chlorine,	0.0	0.0	0.8
	100.0	100.0	100.0

The small amount of matter needed to form a soil of some fertility is well shown by an analysis of beach-sand. The beaches are of two kinds, 1st, the outer beach (young beach), which is nothing but hillocks of white and drifting sand, with no dust in it, and with only a little vegetation of grass and cedars on it: 2d, the inner beach (or old beach,) which, in addition to white sand, contains some fine earth, and is covered with cedar and oak timber and is not now shifiting with the wind. The analyses of the earth of the old beach is shown in this

Analysis.

Silicic Acid and Quartz,	95.44
Alumina and Peroxide of Iron,	3.00
Lime,	0.45
Magnesia,	0.22
Water,	0.30
	99.41

Although this contains scarcely four per cent. of earthy salts, it supports a fair growth of deciduous and evergreen trees. The per centage of sand is so large as to incline to the belief that the other constituents have been introduced in the form of dust by winds and storms.

Taken in comparison with this which would seem to be the lightest of all productive soils, it is interesting to notice the analyses of a soil and subsoil from the East Plains in Burlington county. This is probably the poorest land in the State. It has never supported a growth of trees. Little yellow pines a foot or two high, but mature and bearing cones are there, and dwarf oaks developed in the same way; but nothing to obstruct the view for miles.

Analyses.

	Soil.	Subsoil.
Quartz,	96.525	92.796
Alumina,	0.741	2.745
Peroxide of Iron,	0.285	1.014
Lime,	0.033	0.000
Magnesia,	trace	0.045
Potash,	trace	0.003
Soda,	0.001	0.029
Phosphoric Acid,	0.000	0.013
Sulphuric Acid	0.000	0.000
Chlorine,	trace	0.007
Water,	0.833	1.750
Organic Matter,	1.550	1.358
	99.968	99.760

Marl and lime on this ground will make light crops grow, and there is no doubt from the retentive character of the subsoil that the whole of these plains can be brought into cultivation at a moderate expense.

The soils of Southern New Jersey have generally been reported as barren, but thriving farmers are now to be found in all parts of the district mentioned, and under judicious tillage the land proves to be as productive and as profitable as land in any part of the country, and indeed its warmth and lightness adapt it especially well to the growth of fruit and market garden crops. No better crops can be seen anywhere, than at Vineland, at Clayton, Glassboro, Winslow, Hammonton, or Bricksburg, and these are all places where formerly land was valued only for its growth of pine wood for fuel. Analyses show that these soils are sufficiently retentive, and contain the elements necessary for vegetable growth.

Analyses.

	1.	2.	3.
Silica and Sand,	87.80	86.59	76.45
Alumina,	3.88	7.85	15.00
Peroxide of Iron,	5.17	1.19	
Lime,	0.20	0.66	0.84
Magnesia,	. . .	31	. . .
Potash,	0.44	trace.	0.22
Soda,	trace.	trace.	
Sulphuric Acid,	0.24	. . .	. . .
Phosphoric Acid,	0.19	trace.	. . .
Water,	2.56	4.00	8.70
	100.47	100.60	101.21

These are specimens not above the average. In practice such lands are cleared easier and more cheaply than soils in the northern part of the State. Their peculiarity is that they do not produce valuable crops as soon as they are cleared and without manure, as was formerly thought natural to all new lands. In these it is found necessary that a light dressing of marl, lime, peat, or other fertilizer be used to prepare the ground for the first good crop. Five or ten dollars worth of lime or marl on an acre will secure a good crop of rye the first year, and a succeeding crop of clover, and then the land is ready for any farm crop. The manure put on this land at the first is not equal in value to the cost saved in grubbing and plowing as compared with new lands in other places. In the reports of 1855 and 1856 the value of these lands was presented, and their capability of improvement insisted on. The use of marl in bringing them into cultivation was advocated and the then almost solitary case of cranberry culture was cited. Since that time thousands of farms have been taken up from the forest, and the country is filling up with a moral, intelligent and thrifty population. The lands have proved themselves all that was claimed for them. The cranberry culture has increased from the improved bogs of a few acres to cultivated meadows of hundreds of acres, and the crop is now an important one in the product of our whole country.

Railroads and common roads are being opened through this heretofore neglected country, and it is fast becoming what was long ago predicted of New Jersey, the market garden of the United States.

To help in drawing attention to the capabilities of these new lands has been an important part of the geological survey.

The tide marshes have also been examined. The area of these marshes is so large and the value of them for farming purposes so great that it has been thought important to present reasons for their improvement, and urge that these improvements be made. There are 300,000 acres of these marshes and not more than 15,000 or 20,000 acres have been improved. In Salem and Cumberland counties where most of the improvements have been made the lands prove to be the most valuable and productive of any. They cost nothing for manuring except a trifle for lime; they do not suffer from drouth, and the tillage is very easy. Those parts which are covered with clayey mud are the best; such as are mostly peaty or made of vegetable fibre will need an application of earth or of mineral manure.

The improvements thus far made have depended on shutting out the tide by banks, and draining to low water by sluices. Whenever the improvements shall extend to the parts of the marsh which are from six to thirty feet deep it will be necessary to use pumps in the works of drainage, for though the whole surface is now up to high-water mark, it will settle whenever the water is drawn down, and those parts which consist mostly of peat must go considerably below the present low water mark. The cost of pumping the water out is

not very formidable. Some of the English farm lands as low as these are kept dry at a cost of about four shillings sterling an acre. With a greater amount of rain here it would under good management probably cost $2 a year per acre for drainage. Good lands in the vicinity of cities cost from $20 to $50 a year per acre for manure, when under high cultivation. These lands would not need more than half that value of manure for the same crops so that there would be a large margin for profit even if the expense were much greater than is here stated. Soundings of the marshes in many places have been made, and a number of analyses of the mud of the marshes are given. Of the following (1) is from the seaside, (2) is from the bay-side of Cape May, and (3) is from Salem county.

Analyses.

	1	2	3
Soluble Silica,	25.91	15.69	63.80
Insoluble Silica (sand),	25.94	48.38	
Protoxide of Iron,	6.83	2.92	4.66
Alumina,	14.33	9.40	13.53
Lime,	0.86	2.17	0.34
Magnesia,	1.91	1.66	0.90
Potash,	1.57	2.38	1.48
Soda,	1.39	2.00	1.14
Chlorine,			0.12
Sulphuric Acid,	2.47	1.70	0.30
Phosphoric Acid,	0.34	0.33	0.64
Carbonic Acid,	0.55	0.84	
Organic Matter,	8.62	6.27	10.25
Water,	8.01	5.36	
Hygroscopic Moisture,			2.86
	98.73	99.10	99.74
Ammonia in 100 parts,	0.59	0.31	

The agricultural value of these deposits is due, partly to the fertilizing ingredients they contain, and partly to the extreme fineness of the particles which makes them more easily yield their elements to the growing crops.

The drainage of wet meadows and flowed lands has also received some attention. The great advantages of thorough drainage are being justly appreciated by the community, and the interests of the State are damaged by the backwardness of such improvements. The sluggish current of the Passaic and its branches above Little Falls is a great drawback to the improvement of that beautiful valley. There are 10,000 acres of land along those streams which are liable to over-

flow, and on which the grass is frequently damaged, and in some years entirely destroyed, by freshets. The direct losses on them in 1867 could not have been less than $50,000, and the incidental damages amounted to as much more. From the Lower Bridge at Chatham to Little Falls, which, by the river is twenty-two miles, there is a fall of only about six feet, or three and a quarter inches to a mile. This is not half enough to produce a lively current.

To thoroughly reclaim these lands it would be necessary to destroy a portion of the valuable water power at Little Falls, and to lower the reef of rocks which now makes the obstruction.

There are large bodies of flowed lands along the Wallkill, the Paulinskill, the Pequest, and the upper branches of the Passaic, which in like manner need draining and reclaiming.

To accomplish these useful works, so formidable to individual enterprise, the countenance and co-operation of the State authorities is needed, and the enactment of such laws as may be effective, without being burdensome.

There is much in the results of the survey relating to the mining interests of the State which are necessarily omitted from this lecture. Being intended for farmers, the agricultural bearings of the survey have been mostly dwelt upon. In the prosecution of the work those objects which would most tend to develop the material interests of the State have been kept in view, and investigated as fully as the means appropriated would allow. There are many objects of scientific interest which ought to be more fully described, and there are some works of public utility which it would be gratifying to see carried out.